Math in the Park: K-1st Grade (and siblings)

We had five children playing with the math problems and five adults (counting my teen daughter, who helped when she wasn't taking pictures), so after I introduced a puzzle, we were usually able to work one-on-one with the kids: to respond directly to what each child was doing, reflect their thinking, and offer little suggestions to nudge them along. We adults probably talked more than we should have—listening without offering advice has always been hard for me.

I started out by asking the kids, "What is math?" Kia said "Counting!" and they were all eager to tell me how high they could count. When I asked for more ideas of what math is, the others came up with *practicing* and *learning ABCs* (apparently in his mind the question had morphed to "What is school?", but I agreed that math definitely included some ABCs).

I've asked this question to several groups of children and parents, and the first answer always involves numbers: *counting*, *adding and subtracting*, *arithmetic*, *doing problems*—how they express it will vary from group to group, but the basic idea is that "Math = Numbers." If I keep asking, I will usually get *algebra* and *geometry*, sometimes *logic*, and after that even most adults run out of ideas.

I told them we had four math puzzles, but only one of the puzzles would have numbers. We played with two problems with the whole group, and then the younger siblings ran off to the playground while the older kids tried the last two puzzles.

Gears

I had set out the gears toy for free play, and Samson and Kia tried it out while we waited for the other kids to show up. Rather than making lines or loops of gears, as I had expected, they put all the gears on at once (a 4-by-4 grid of interconnected gears) and spun them.

When we started working together, I said our first problem would be about *rotation*, which was an unfamiliar word to the kids. I had my daughter stand up and spin herself to demonstrate rotation (and of course all of the kids recognized the idea of spinning in circles), and then had everyone stand up and try it. It was interesting that almost everyone started spinning clockwise—only one of the mothers spun counterclockwise.

Then I had two parents to stand up and spin while the kids watched: first the same direction, and then opposite directions. I asked what the children noticed: “They’re going slower!” (Yep, the moms were getting dizzy.) Those two sat down and two others got up, and when I asked more pointedly whether they were spinning the same direction or different directions, the kids could identify both motions.

Feeling pretty optimistic, I moved on to the gears toy. We turned the handle and added one gear at a time, up to three gears. When I asked whether they were spinning the same direction or different, I got mixed answers: “The same ... they’re going ‘round ... they’re going all directions.” (Which puzzled me at first, but then I realized that is what rotation looks like: one side of the gear is moving toward the child while the other side moves away, and the top and bottom are going right and left, so the gear is going all directions at once.) Even when we slowed the gears down, everything moving at once caused a visual overload that made it hard for the children to distinguish between the motions. The gears were just “going around.”

We took out the second gear in a line and asked why the others wouldn’t spin. “They need to be touching!” One of the moms put a couple of gears together but not by the handle: “These two are touching, will they spin?” The kids weren’t fooled. “No! They need one HERE.” (Next to the handle.) I think one boy reached out and spun them with his finger.

We finally got one set of gears moving slowly enough that Samson was able to see, “These two are going this way, and the one in between is going that way.”

By this time, I was a bit worried about handing out our worksheet (which I printed from James Tanton’s *Math Without Words*). If the kids couldn’t separate the two motions on the physical gears, how would they be able to imagine the movement on paper? To my surprise, the children found the pictures easier to work with than the physical gear set, perhaps because the lack of motion let them focus on the teeth where two gears met: this gear is turning this way, so which direction will it push the next gear? All five children worked intently for several minutes.

The three older children successfully solved even the challenge puzzle (the long, branching line of gears)—well, sort of: I think I saw final answers that went both directions, so one of them must have been wrong, but the kids clearly understood how each gear turned the next one, even if they lost track of which way the arrows were pointing as they went along. The younger siblings had the idea of spinning, but drawing arrows to keep track of direction was beyond them: Abby drew circles inside most of the gears, though she skipped some of the smaller ones, and Danny made several long chains of circles on his paper.

Planet PeeYu

I told the story that Jesse Carrell suggested about Planet PeeYu, and the kids (and parents) seemed to enjoy it. Then we moved to the grass to make body shapes, which I thought the kids would enjoy, but that didn’t go well. I think they weren’t sure what I expected, which made them shy. Abby made a nice straight line with her body, and then realized that the sun was in her eyes, so she started rolling around, which made it hard for Kia to lie next to her and make an angle. The boys completely rejected the game, so we moved back to the tables and made shapes with action figures instead.

It was interesting to watch the progression of shapes the kids made with the action figures. They began by making straight lines, then Samson put two figures parallel to each other—which his mom wasn't sure should count :) —and Kia made a 90-degree angle. Then the kids branched out to other angles, stars (heads together), and combination shapes like a star with a line stretching out from it. Nobody thought of putting the figures in a loop until I suggested it, and then it was enough of a challenge for them to figure out how make the line curve back and connect. I didn't push the question from the handout (whether six action figures could make a loop that required four pillows).

Sorting Sums

I adapted the exponents problem as an addition puzzle, to put in order the sums 10+8, 5+12, and 2+24. I used a three-bears coloring picture (Papa Bear likes big numbers, etc.) for sorting out the answers. The kids immediately said that 24 was a Papa Bear number and 2 belonged to Baby Bear. Samson and Micah insisted that 1 should be on the page somewhere because it was wrong to let 2 be the smallest number, and then Samson pointed out that zero was even smaller than one.

None of the children recognized the sums as representing individual things to be sorted. In their opinion, "10+8" wasn't a number.

I had forgotten to bring blocks to model the sums, so I drew dots on a white board. I wrote each number with its associated dots, and then drew circles around the addition pairs. The three children took turns, each counting accurately all the dots in one of the sums. None of them thought to try a different strategy than counting all.

Finding Paths

I copied Facebook pictures to make a worksheet with the three families, putting the kids on one side and the parents on the other. I made an easier puzzle than the one in the handout, leaving white space around all four edges instead of than having some pictures go all the way to the edge.

On my copy, I drew lines straight between the parents and children, and asked them what would happen if they all ran home that way. We agreed that they would crash into each other and that someone might get hurt.

Kia saw the “around the outside” solution right away. After drawing one set of paths that didn’t cross, she erased them (the worksheets were laminated so we could use dry-erase markers) and found a different solution.

The boys came up with different plans. Micah drew one line straight to the parents and then two shorter lines that stopped before crossing the first. “These two are waiting.” That made sense: if they wait their turns, there’s no danger of a crash. Samson drew one line fairly straight and the other two with big zig-zags, which probably accomplished the same thing. Zig-zaggy paths would take longer, so the children wouldn’t be crossing the intersection point at the same time.

Conclusion

The kids went to the playground while the parents helped pick stuff up. Kia told my other daughter, who was acting as playground guard: “I’m done with math. It was really fun!”